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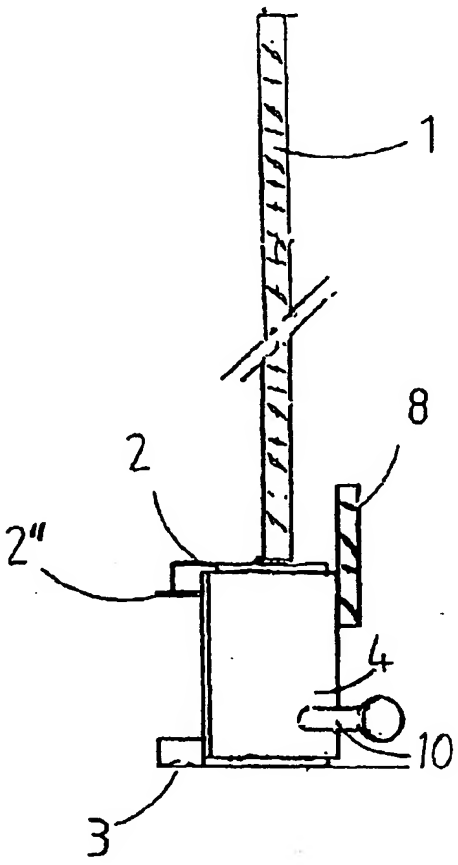
(54) Title: SPOT FOOTING



(57) Abstract: Spot footing designed especially for securing a precast concrete or timber column to a foundation and/or for extending such a column, said spot footing comprising a base plate (3) provided with a mounting hole (7), and a substantially cylindrical, rigid protective casing consisting of a top plate (2) and a side wall part (4, 6) having an opening (5), an anchor bar being secured to said top plate (2). The spot footing comprises two or more anchor bars (1) secured to the top plate (2) and specifically so disposed in the top plate that the anchor bars are located substantially around the hole (7) of the base plate (3).

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

SPOT FOOTING

The present invention relates to a spot footing needed for joining a precast concrete column and a timber column to a foundation or for extending such a column, as defined in the preamble of claim 1.

Precast concrete columns are extended to each other and joined to the foundation by a currently known technique in such manner that, at the element factory, a spot footing is placed at the lower end of the precast column, the anchorages of the spot footing being cast in the column. The foundation or the upper end of the column to be extended is provided with a threaded bar whose upper end is fastened in a hole in the spot footing. The joint can also be made the other way round so that a spot footing is mounted in the upper surface of the foundation and a threaded bar is fixed to the column. This alternative method is employed when timber columns are used, when the concrete column has a small cross-section, when the reinforcement has been implemented by using prestressing cables, or when it is to be feared that earthwork may damage the threads of the bolt. The function of the joint structure in a finished structure is based on the principle that the compressive forces are transmitted by the concrete fills made on site while the tensile forces are transmitted by the threaded bars fixed with nuts to the spot footings. During the mounting of the elements, before the concrete filling, compressive force are also transmitted via the nut casing structure of the spot footing. The reinforcement of the concrete column consists of ribbed bars or prestressing cables, the number of which placed in the cross-section is such that the loads can be safely transmitted from the upper end of the column structure down to the foundation. Loads are imposed on the columns from the roof structure, the intermediate floors and the wall structures. The greatest stress is thus imposed on the lower end of the column. In long columns reinforced by ribbed bars, the bar size and/or the number of bars increases according to the required load. Depending on the load and the manner of construction of the reinforcing cage, one or more reinforcing bars or tension cables are used at the corners of the column. In the case of large concrete cross-sections, reinforcing units are placed on the sides as well. Forces are transmitted in the spot footings and extension bolts via the ribbed bar anchorage to the main reinforcement, so the total amount of reinforcement depends on the strength of the concrete and the manner of transmission of forces. In contact splices of the re-

inforcing bars, tensional forces are transmitted via the anchorage from one bar to the other, whereas in the case of prestressing cables it is only required that the ribbed bar be anchored in the concrete compressed by pretensioning. The anchoring bars of spot footings are so disposed that the structure achieves a sufficient protection against corrosion and fire and fits the main reinforcement and bolt layout.

The general functioning principle of the spot footing in respect of material strength is that the tensional force of 500-1500 kN coming from the foundation anchor bolt is fixed to the footing base plate by means of bolt nuts, from which the force is transmitted sideways to a distance of 50-100 mm along the footing structures and then the force is again returned in the upper part of the footing back to the column's main reinforcements aligned with the anchor bolt. Transmitting this great force laterally and returning it back in the footing area causes very high internal stresses on the footing structures.

An optimal footing structure regarding force transmission is obtained when the lateral transmission of tensional force from the anchor bolt line is as small as possible in the footing structure. In this way, the internal eccentricity forces in the bolt and the need for balancing of internal forces are reduced.

The lightest spot footing structure would be obtained by adapting the spot footing in each application to the amount of main reinforcement and the disposition of the reinforcements. In this case it would not be possible to utilize industrial serial production to reduce the manufacturing costs. Specification EP-A2-0900898 discloses a rigid cylindrical nut casing structure and an anchor bar centric in relation to the bolt hole, requiring no separate main reinforcement of the column.

The solution in question has the drawbacks that, in long columns the amount of reinforcement can not be reduced in the parts closer to the upper end of the column, the transportation of long bars needed in columns extending through several floors is difficult, and the solution can not be used when the columns are produced by prestressing.

Specification DE-A1-195 14 685 discloses a spot footing comprising a base plate, a protective casing formed from thin sheet, main anchor bars and balanc-

ing anchorages and, to achieve a lighter spot footing structure, a rigid angle iron structure secured to the base plate so that the planes of its legs are perpendicular to the base plate. The angle iron structure has been fitted to direct the balancing forces transversely relative to the forces generated by the bolt fitted in the bolt hole and the main anchor bars so that the balancing forces will not increase the required capacity of the main anchor bars. The main anchor bars can be secured to the inner or outer surface of the angle iron structure or to a separate rigid plate transverse to the angle iron structure, which plate may be similar to the base plate and which can be welded to the upper edge of the angle iron structure so that it extends above the protective casing. In respect of material strength, the function of the spot footing is based on the base plate and the angle iron welded on it, to which the anchor bars are welded. In addition, as parts of the footing, the molding boxes in the top and in the side of the angle iron have no function in respect of material strength. Moreover, the footing comprises balancing parts. A drawback with the spot footing according to specification DE-A1-195 14 685 is that the center of gravity of the angle iron lies far from the bolt hole, and the center of gravity of the anchor bars, being welded to the angle iron, is also far from the bolt hole. The internal eccentricity forces in the footing grow large and separate balancing parts are needed. The top plate has no function in respect of material strength, it is only a concrete casting shield.

In the solution disclosed in the present invention, the prior-art solution used in the above-mentioned specification EP-A2-0900898 is partly made use of as regards the compact casing structure. The structure of the spot footing of the invention allows serial production that is more comprehensively economical in view of the processing costs and column reinforcement costs when long columns extending through several floors are to be manufactured or when a column structure is to be prestressed.

The present invention is based on a solution where two or more anchor bars are secured to the top of the spot footing, the bars being so disposed that the main reinforcement of the column can be placed as close to the center line formed by the bolt as possible. In the reinforcing cage, the main reinforcement is thus at the corner of the hook. By using several bars, the number of anchor bars can be more easily adapted so that it corresponds to the bolt force. If the column is produced by prestressing, then the top of the casing can be provided with a

hole, through which the cable is threaded through the hole in the base plate to the prestressing bed. When the casting mold is dismounted, the cable is cut below the top of the casing. The hole in the base plate can be made elliptical, thus allowing the spot footing to be used with different protective concrete layers on the bolts. Therefore, production can be implemented in longer series, more efficient production can be achieved and the storability can be improved. To allow greater mounting tolerances, the bolt hole is always made larger than the bolt diameter. By using an elliptical hole, the mounting tolerance is increased. The slight eccentricity between the anchor bars and the bolt is dealt with simply by adding one or more anchor bars to the back wall of the casing. As a result, the anchor bars on the top and behind the casing form a force couple balancing the eccentricity. In the finished structure, the steel parts of the spot footing have to be protected against fire because, when the temperature rises, the yield strength and load-bearing capacity of the steel are reduced. Load-bearing steel parts are generally placed inside second-stage concrete. In an embodiment of the invention, the part of the top of the nut casing in the area of the opening of the casing is made from thin sheet, which is so shaped that it centers the part into alignment with itself and seals the structure so that no concrete can flow into the casing. In the finished structure, the concrete constitutes a fire shield for the thick structural casing top part, so the spot footing need not be entirely embedded in the floor concrete.

In the solution of the present invention, the casing is so shaped that, in respect of material strength, its center of gravity is located at the center of the bolt hole. The anchor bars are secured to the top plate, which, in respect of material strength, functions as a force-transmitting part and simultaneously as a casting shield. The center of gravity is as close to the center of the bolt hole and also to the main bar of the column corner as possible, which is why an anchor bar is needed to eliminate this slight eccentricity. In this solution, the internal eccentricity forces in the footing are minimized by a casing design and disposition of anchor bars correct in respect of material strength and by securing the anchor bars to the casing top instead of to the wall.

The features of the solution of the invention are presented in detail in the claims below.

In the following, the invention will be described in detail by the aid of an example with reference to the attached drawing, wherein

Fig. 1 presents a spot footing according to the invention in side view,

Fig. 2 presents the spot footing of the invention in top view,

Fig. 3 presents an embodiment of the spot footing of the invention in top view,

Fig. 4 presents the spot footing of the invention in side view as seen from the direction of the opening of the casing, and

Fig. 5 presents the spot footing of the invention in top view and sectioned through the casing.

Fig. 1 - 5 present a spot footing according to the invention, comprising a rigid nut casing having a base plate 3, a top plate 2' and a wall part 4, all made of sufficiently thick iron plate, so that the loads are transmitted via anchor bars and the top, wall part and bottom of the nut casing to the foundation.

Parts 1 shown in Fig. 1 and 4 are anchor bars of the footing, which are secured to the top plate 2 of the footing casing either by welding or by means of screw threads. Part 1 anchors the spot footing to the reinforced concrete structure. An embodiment of the invention comprises two or more anchor bars 1 specifically so disposed that the anchor bars are positioned around the hole 9 made in the footing top plate 2 for the main reinforcement as illustrated in Fig. 3.

The hole 9 corresponds to the center of the hole 7 of the base plate 3, where the main reinforcement bars or prestressing bars of the column are located, so the main reinforcement of the concrete column can be connected onto the top plate 2 at a point corresponding to the bolt hole 7 of the base plate 3. This embodiment is used in prestressed columns, in which the tendons have to be drawn through the structure from end to end of the mold. The footing base plate 3 corresponds in shape to the cross-sectional area of the casing structure. In the area of the opening 5 of the casing, the base plate 3 is so shaped that it corresponds to the cross-section of the concrete. The footing shown in the figure is thus used at the corner of a column of beveled rectangular cross-

thus used at the corner of a column of beveled rectangular cross-section. In the case of a round column the base plate has a round edge, and when the spot footing is placed on the side of a rectangular column, it is straight. At the center of the base plate 3, a hole 7 is provided for the foundation anchor bolt of the lower floor. In a solution according to the invention, the bolt hole 7 has an elliptical form, allowing the same spot footing to be used in different bolt applications. Depending on the protective concrete layers required, the bolt is positioned either in the inner part of the hole 7 or at its outer edge. Part 4 forms the side wall of the protective nut casing, and it has a cylindrical structure or a polygonal structure bent into a cylindrical shape, provided with an opening 5 on one side of it to allow the nut to be mounted. The edges 6 of the opening 5 of the protective casing 4 are bent to match the base plate 3 of the casing. The shaping of the edges 6 and opening area of the base plate 3 guides the footing against the edges of the column mold. The top plate 2 consists of two parts, a structural thicker part 2', to which the anchor bars are secured, and a formed part 2" manufactured of thin plate, applied against the column mold. In the cast structure, only the thin formed part 2" transfers heat to the structural part 2' in a fire situation. It is thus not necessary to cast the top part 2 of the casing inside the floor structure to provide protection against fire. The various parts of the casing structure are assembled by welding.

Welded to the back side of the side wall part 4 of the protective casing is a vertical anchor bar 8, which is placed on an axis of symmetry and which, together with anchor bars 1, forms a force couple balancing the eccentricity, and horizontal tie bars 10 on either side of the axis of symmetry.

Practical applications of the spot footing include precast concrete columns and foundation columns. From the precast concrete column, only the threaded bars protrude, and these are mounted inside the spot footing.

The invention is not limited to the embodiments described above; instead, it can be varied within the scope of the following claims.

CLAIMS

1. Spot footing designed especially for securing a precast concrete or timber column to a foundation and/or for extending such a column, said spot footing comprising a base plate (3) provided with a mounting hole (7), and a substantially cylindrical, rigid protective casing consisting of a top plate (2) and a side wall part (4, 6) having an opening (5), an anchor bar being secured to said top plate (2), **characterized** in that the spot footing comprises two or more anchor bars (1) secured to the top plate (2) specifically so disposed in the top plate that the anchor bars are located substantially around the hole (7) of the base plate (3).

2. Spot footing according to claim 1, **characterized** in that one or more vertical anchor bars (8) are secured, e.g. by welding, to the back side of the side wall part (4) substantially on an axis of symmetry.

3. Spot footing according to claim 1, **characterized** in that the side walls (4, 6) of the protective casing are so shaped that the center of gravity of the cross-section of the wall is located substantially at the center of the bolt hole (7).

4. Spot footing according to claim 1, **characterized** in that the hole (7) of the base plate (3) is elliptical.

5. Spot footing according to claim 1, **characterized** in that the top plate (2) of the protective casing is provided with a round hole (9) located in alignment with the hole in the base plate (3), allowing the use of prestressing cables.

6. Spot footing according to claim 1, **characterized** in that the top plate consists of a thicker force-transmitting part (2) and a thin protective casing part (2"), which is fitted against the column mold.

7. Spot footing according to claim 6, **characterized** in that the top plate (2) consists of two parts (2', 2") of different thicknesses, either so that the top plate (2) edge (2") fitted against the column mold is made of thinner material than part (2') to which the anchor bars have been secured, or so that the thinner part is secured to the frontal surface of the thicker part.

Fig 1.

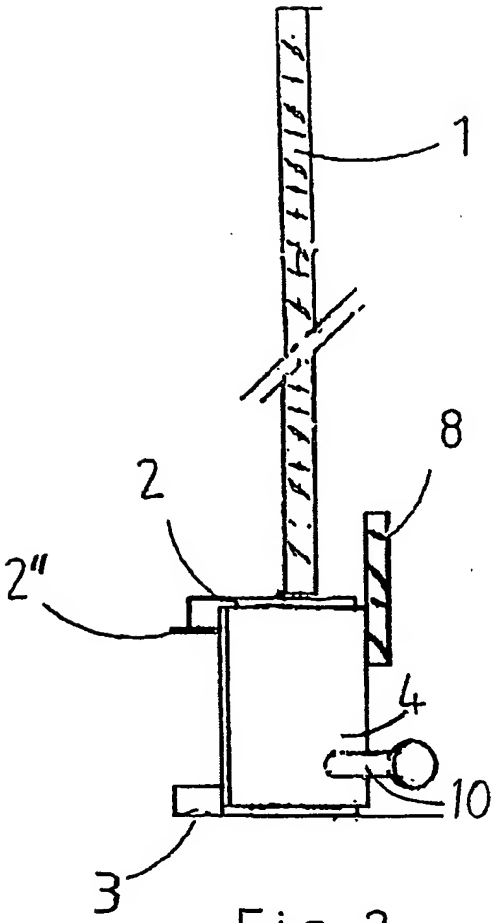


Fig 4.

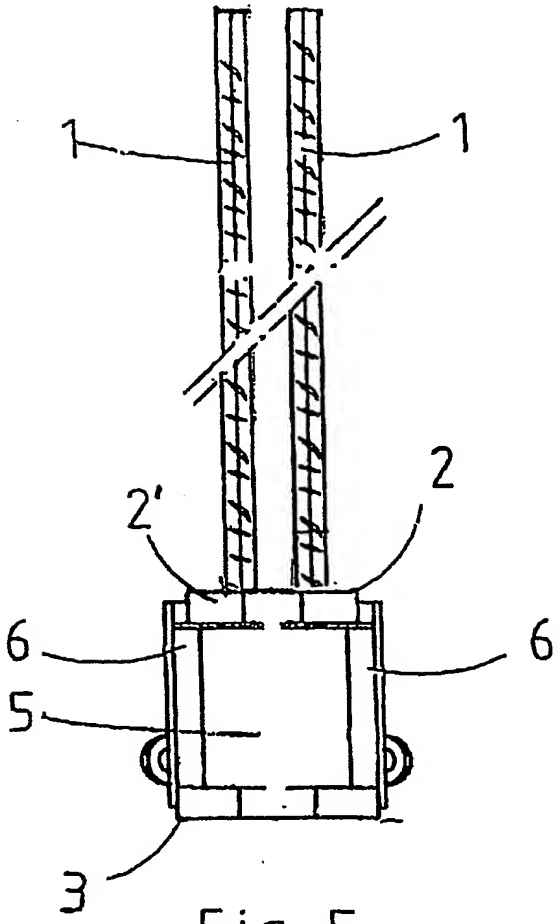


Fig 2.

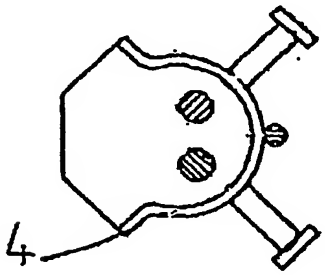


Fig 5.

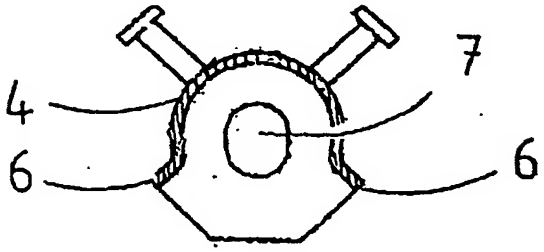
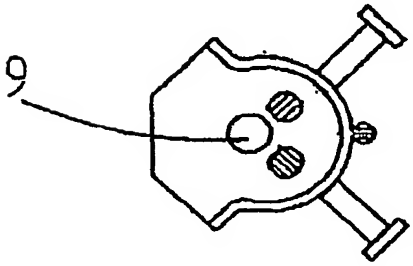


Fig 3.



INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00159

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E04H 12/22, E04B 1/21
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E04B, E04C, E04H, E02D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-INTERNAL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0952265 A2 (PEIKKO GMBH), 27 October 1999 (27.10.99), column 3, line 6 - line 54, figures 1, 2	1-4
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X	FI 95164 B (MÄKINEN, A.), 15 Sept 1995 (15.09.95), figures 1,2, abstract	1-4
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A	EP 0900898 A2 (TARTUNTAMARKKINOINTI OY), 10 March 1999 (10.03.99), figures 1-4, abstract	1-7
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[X] Further documents are listed in the continuation of Box C. [X] See patent family annex.

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 03/00159

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	DE 19514685 A1 (TERÄSPEIKKO OY), 16 November 1995 (16.11.95), column 2, line 53 - column 3, line 2, figures 1-7	1-7
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A	DE 20002501 U1 (PFEIFER HOLDING GMBH & CO. KG), 11 January 2001 (11.01.01), page 17, line 21 - page 19, line 26, figures 1-6	1-7
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INTERNATIONAL SEARCH REPORT
Information on patent family members

29/04/03

International application No.
PCT/FI 03/00159

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